Appl. No. : 10/621,196
Filed : July 15, 2003

AMENDMENTS TO THE SPECIFICATION

In the Specification:

Please amend the specification as follows. Insertions appear as underlined text (e.g., insertions) while deletions appear as strikethrough text (e.g., ~~strikethrough~~). All previously amended claims appear as clean text.

Please amend paragraph [0084] as follows:

The Z-Axis Power Supply (ZPS) 18 provides DC power to the Z-Axis Controller and Amplifier (ZCA) 315 for energizing the electromagnets (EM) 132Z and 138(Z) that are located outside the patient's body. ZCA 315 monitors the sensor arrays of the Z-axis that include the following components: temperature sensor (TS) arrays 316, 319, and magnetic field sensor arrays 317, ~~319~~ **318**. Magnetic field sensor arrays 317 and 318 measure the magnetic flux in the Z axis. Temperature sensor (TS) arrays 316 and 319 measure the temperature of magnetic field sensor arrays 317 and 318, so that Z Axis Controller and Amplifier (ZCA) 315 can apply temperature compensation factors to the magnetic field sensor outputs. The sensory outputs of these arrays 316, 317, 318, 319 provide feedback to the servo system controlled by ZCA 315 concerning the position of the present catheter tip 377 with reference to the Z-axis. As it will become apparent from the present description, these electromagnets 132Z and 138Z affect the position of the present catheter tip 377 inside the patient's body 390 in the Z-axis.

Please amend paragraph [0108] as follows:

[0108] Still referring to FIG. 8, current source 121y provides the control current to bias the magnetic field sensors 113Y, 114Y 115Y, 116Y, 117Y, 118Y, 119Y, and 120Y, since they operate best in a constant current mode and require stability for reliable sensing. Temperature sensor bias supply 130y supplies the voltage for the temperature sensors 122Y, 123Y, 124Y, 125Y, ~~126Y.~~ **126Y,** 127Y, 128Y, and 129Y.

Please amend paragraph [0122] as follows:

[0122] FIG. 11 illustrates the electrical circuitry of the calibration fixture (CF) 321 and FIG. 12 illustrates the mechanical implementation of the calibration fixture (CF) 321. The purpose of the ~~CF,~~ CF 321, is to define the steps and limits of motion in each possible direction of the virtual tip 405. This information is communicated to the VT/CFC 303 and used to synchronize the electronic circuitry and physical operations during normal operation of the GCI apparatus 501.

Please amend paragraph [0128] as follows:

[0128] FIGS. 13C, 13D, 13E, 13F, 13G and 13H, show an alternative architecture of the GCI apparatus 501 whereby the polar configuration noted in FIGS. 16. 16A, 16B, and 16C, is altered to accommodate the cluster configuration of the electro-magnet circuit as shown in FIG. 13A and 13B. FIG. 13B is a simplified block diagram of the electrical scheme of the various components of the system. The system comprises a power ~~supply, 910~~ **supply 916**, a j~~oystick, 900~~ **joystick 900**, feeding three channels, X, Y, and Z, where the three signals taken together form a matrix **V**, 923, shown in FIG. 13D, comprising elements Vj_x, Vj_y, and Vj_z. This arrangement is further explained in FIG. 13D, 13E, 13F, 13G and 13H. FIG. 13C, the X-axis channel, comprises an Op-Amp 911, a current amplifier 910, and coil pair 901, 903. The Y-axis channel comprises an Op-Amp 913, a current amplifier 912, and coil pair 902, 904. The Z-axis channel comprises an Op-Amp 915, a current amplifier 914, and coil pair 905, 906. As shown, each pair of coils is connected in series and further connected to the output of power amplifiers, 910, 912, and 914, for the X, Y and Z axes, respectively. The alternative architecture to FIG. 1 shown in FIG. 13C receives its input signal command from the joystick, 900. Upon command from the operator using the joystick 900 to move in one or more axes, the joystick 900 sends its signal to an array of operational amplifiers, 911, 913, and 915, corresponding to the X, Y, and the Z axes respectively. Op-Amps 911, 913, and 915 translate the signal received from joystick 900 and perform an Inverse operation on the matrix of the three signals for the three axes. The Op-Amp array 932 multiplies the signal from joystick 900 represented as vector **V**, 923, by another

matrix **M**-inverse, shown in FIG. 13F and 13G as 927, such that the output of the Op-Amp array 932 is **M**-inverse times **V**, where **M** is the characteristic matrix 925 of the cluster arrangement comprising the six coils 901 through 906. The output from the Op-Amp array 932, comprising Op-Amps 911, 913, and 915, is obtained, and is fed to power amplifiers 910, 912, and 914, driving the six coils 901 through 906 to obtain the result of generating a motion in the desired direction, hence providing the apparatus 501 with the ability to translate the desired motion of the operator or the clinician as to move the catheter tip 377 in a body lumen of a patient, 390. This scheme as shown in FIG. 13D, 13E, 13F, and 13G, is reduced further in FIG. 13H where the input signal **V**, 931, from Joystick 900, is fed to an **M**char-Inverse Op-Amp array, 932. The resultant output from the array 932 is the matrix product **M**char-Inverse by the vector **V**. This signal is fed to current amplifiers 928, their signal output represented by the vector **B**, 933, is then fed as the respective current to the coils 901 through 906, thereby producing the result of translating the hand-movement of the clinician into the appropriate signal, thus moving the catheter tip to the desired location.

Please amend paragraph [0168] as follows:

[0168] FIG. 20A further illustrates components of the position vectors 622 and 621 obtained by additional mathematical manipulation and calculations done on the signals that are received from the magnetic field sensors X1, X2, X3, and X4. The location of the actual tip 377 is defined by the position co-ordinates shown as 621 and 622. Position 623 is the measured position of the actual catheter tip 377 as determined by the magnetic field sensors X1, ~~**X2, X3, and X4**~~ **X2 and X3**, and position 624 is its calculated position as determined by the system control 302. Under ideal conditions, the positions 623 and 624 are equal to each other.